

SUPPORT FOR THE AMENDMENT

This Amendment amends the specification to reflect a new Fig. 5 showing features of Claim 4; cancels Claim 5; amends Claims 1-4 and 6; and adds the new Fig. 5. Support for the amendments is found in the specification and claims as originally filed. In particular, support for the amendments to the specification and Fig. 5 is found in the specification at least at page 15, line 26 to page 16, line 27 and in original Claim 4. Support for Claim 4 is found at least in Claim 1 and in canceled Claim 5. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-4 and 6 will be pending in this application. Claim 1 is independent.

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Applicants thank the Examiner for the courtesies extended to their representative during the personal interview on October 2, 2003.

As discussed at the interview, the present invention provides a method of observing the internal structure (packing structure or dispersion condition of particulate material) of a composite of ceramic particles in a liquid matrix utilizing (i) photoelasticity based on local rearrangement of liquid material molecules or (ii) the difference of refractive indices between the particles and the liquid material.

In polymeric material systems, polarized light is typically used for observation and evaluation of photoelasticity characteristics with applied stress, birefringence of a plastic lens, and molecular alignment characteristics in liquid crystal materials. However, no attempts have previously been made to use these techniques to evaluate the characteristics of

particles dispersed in liquid materials because it was not anticipated that these methods of observation could be applied to particulate materials having isotropic crystalline structure or no crystalline structure. See, e.g., specification at page 6, line 25 to page 7, line 13.

Claims 1-6 are rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 4,786,802 ("Yoshii") or U.S. Patent No. 5,903,352 ("Ohsaki").

Yoshii discloses an apparatus for measuring the photoelasticity in materials such as glass, plastic, Si monocrystal substrates, polycrystalline Si semiconductor substrates, amorphous Si substrates, transparent objects, molded articles of opaque resins and thin films. See Yoshii at Abstract; column 1, line 16; column 5, lines 30-36.

Ohsaki discloses an apparatus for measuring optical anisotropy in liquid crystal cells. See Ohsaki at Abstract; column 17, lines 18-19.

Applicants thank the Examiner for the indication at the personal interview that neither Yoshii nor Ohsaki suggests the limitations of (i) "mixing *particulate material* as raw material with a *liquid material* to obtain a composite material filled with ceramic particles" and (ii) "*making visible* the internal structure of the composite material ..., and then observing the internal structure, wherein the internal structure of the composite material is the *packing structure or dispersion condition of the particulate material* in the composite material". See Interview Summary dated October 2, 2003.

Because the cited prior art fails to suggest all the limitations of the claimed invention, the rejection under 35 U.S.C. § 103(a) should be withdrawn.

Claims 1-6 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-8 of co-pending application 09/748,003. The '003 claims are directed to transmitting light from a light source through a composite and observing "transmission-polarization images". However, light polarization is a significantly different phenomenon than the photoelasticity and refraction

featured in independent Claim 1. See, e.g., the definitions of polarization, birefringence, photoelasticity, refractive index and index of refraction in McGraw-Hill Dictionary of Scientific and Technical Terms, 5th Ed., pages 231, 1004, 1495, 1537 and 1676, (copies attached). Because the "transmission-polarization" of the '003 claims fails to suggest the independent Claim 1 features relating to "photoelasticity" and "difference of refractive indices", and there is no reasonable expectation that the "transmission-polarization" of the '003 claims would have successfully led the skilled artisan to observe internal structure using photoelasticity or a difference in refractive indices, the double-patenting rejection over the claims of '003 should be withdrawn.

The drawings are objected to under 37 C.F.R. § 1.83(a). To obviate the objection, a New Drawing Sheet showing new Fig. 5 is attached.

Claims 4-6 are rejected under 35 U.S.C. § 112, second paragraph. To obviate the rejection, the phrase "such as" is deleted from Claim 4.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Attachments:

New Drawing Sheet showing Fig. 5
McGraw-Hill Dictionary of Scientific and Technical Terms, 5th Ed., pages 231, 1004, 1495, 1537 and 1676

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of the hevea rubber tree caused by the fungus *Helminthosporium heveae*. { 'bædz 't,spæt }

birectangular [MATH] Property of a geometrical object that has two right angles. { 'bi'rek'taŋ'gyə-lər }

birefringence [OPTICS] 1. Splitting of a light beam into two components, which travel at different velocities, by a material. 2. For a light beam that has been split into two components by a material, the difference in the indices of refraction of the components within the material. Also known as double refraction. { 'bi'ri'frin'jəns }

birefringent filter [OPTICS] A filter consisting of alternate layers of polarizing films and plates cut from a birefringent crystal; transmits light in a series of sharp, widely spaced wavelength bands. Also known as Lyot filter; monochromatic filter. { 'bi'ri'frin'jənt 'fil-tər }

birefringent plate [OPTICS] A piece of birefringent optical material with parallel plane surfaces. { 'bi'ri'frin'jənt 'plāt }

Birge-Mieck rule [ATOM PHYS] The rule that the product of the equilibrium vibrational frequency and the square of the internuclear distance is a constant for various electronic states of a diatomic molecule. { 'birgə 'mēk 'rül }

Birge-Spinner extrapolation [SPECT] A method of calculating the dissociation limit of a diatomic molecule when the convergence limit cannot be observed directly, based on the assumption that vibrational energy levels converge to a limit for a finite value of the vibrational quantum number. { 'birgə 'spɒn-ər 'ik, 'strəp-ə 'lā-shən }

birimose [BOT] Opening by two slits, as an anther. { 'bi'ri,mōs }

Birkeland-Eyde process [CHEM ENG] An arc process of nitrogen fixation in which air passes through an alternating-current arc flattened by a magnetic field to form about 1% nitric oxide. { 'bærk-lænd 'i'də 'præs-əs }

Birkhoff's theorem [RELAT] A theorem which states that if a space-time containing matter or energy satisfies Einstein's equations of general relativity and is centrally symmetric, then it is necessarily static and under a coordinate transformation it becomes identical to the Schwarzschild solution. { 'bærk,hōfs 'θiərəm }

Birmingham wire gage [DES ENG] A system of standard sizes of brass wire, telegraph wire, steel tubing, seamless tubing, sheet spring steel, strip steel, and steel plates, bands, and hoops. Abbreviated BWG. { 'bærmɪŋ-əm 'wɪr 'gæj }

birotulate [INV ZOO] A sponge spicule characterized by two wheel-shaped ends. { 'bi'ratch-ə,lāt }

birth [BIOL] The emergence of a new individual from the body of its parent. { 'bərth }

birth canal [ANAT] The channel in mammals through which the fetus is expelled during parturition; consists of the cervix, vagina, and vulva. { 'bərth kə'næl }

birth control [MED] Limitation of the number of children born by preventing or reducing the frequency of impregnation. { 'bərth kən'trəl }

birth-death process [IND ENG] A simple queuing model in which units to be served arrive (birth) and depart (death) in a completely random manner. [STAT] A method for describing the size of a population in which the population increases or decreases by one unit or remains constant over short time periods. { 'bərth 'deth 'prə,səs }

birth defect See congenital anomaly. { 'bərth di'fekt }

birthmark [MED] Any abnormal cellular or vascular benign nevus that is present at birth or that appears sometime later. { 'bərth,mærk }

birth process [STAT] A stochastic process that defines a population whose members may have offspring; usually applied to the case where the population increases by one. { 'bərth 'prə,səs }

birth rate [BIOL] The ratio between the number of live births and a specified number of people in a population over a given period of time. { 'bərth ,rāt }

bis- [CHEM] A prefix indicating doubled or twice. { bis }

2,2-bis(para-chlorophenyl)-1,1-dichloroethane [ORG CHEM] C₁₄H₁₀Cl₄ A colorless, crystalline compound with a melting point of 109–111°C; insoluble in water; used as an insecticide on fruits and vegetables. Also known as DDD; TDE. { 'ti 'ti,bis 'parə ,klɒrə'fɛn-əl 'wɛn 'wɛn di ,klɒrə'e,θæn }

bischofite [MINERAL] MgCl₂·6H₂O A colorless to white, monoclinic mineral consisting of magnesium chloride hexahydrate. { 'bish-ə,fi }

biscuit [ENG ACOUS] See preform. [MATER] 1. A clay object that has been fired once prior to glazing. 2. Pottery that is unglazed in its final form. [MET] An upset blank for drop forging. { 'bis-kət }

biscuit cutter [MIN ENG] A short (6–8 inches or 15–20 centimeters) core barrel that is sharpened at the bottom and forced into the rocks by the jars. { 'bis-kət 'kæd-ər }

bise [METEOROL] A cold, dry wind which blows from a northerly direction in the winter over the mountainous districts of southern Europe. Also spelled bize. { bēz }

bisection algorithm [MATH] A procedure for determining the root of a function to any desired accuracy by repeatedly dividing a test interval in half and then determining in which half the value of the function changes sign. { 'bi'sek-shən 'al-gə,rɪθ-əm }

bisector [MATH] The ray dividing an angle into two equal angles. { 'bi'sek-tər }

bisectrix [CRYSTAL] A line that is the bisector of the angle between the optic axes of a biaxial crystal. { 'bi'sek,triks }

biserial [BIOL] Arranged in two rows or series. { 'bi'sir-ē-əl }

biserial correlation coefficient [STAT] A measure of the relationship between two qualities, one of which is a measurable random variable and the other a variable which is dichotomous, classified according to the presence or absence of an attribute; not a product moment correlation coefficient. { 'bi'sir-ē-əl ,kär-ə'lā-shən ,kō-ə,fɪʃ-ənt }

biserrate [BIOL] 1. Having serrated serrations. 2. Serrate on both sides. { 'bi'ser,āt }

bisexual [BIOL] Of or relating to two sexes. [PSYCH] 1. Possessing mental and behavioral characteristics of both sexes. 2. Having sexual desires for members of both sexes. { 'bi'sek-shə-wəl }

Bishop's ring [METEOROL] A faint, broad, reddish-brown corona occasionally seen in dust clouds, especially those which result from violent volcanic eruptions. { 'bish-əps 'rɪŋ }

bisilicate [MET] A type of slag whose silicate degree is 2. [MINERAL] See metasilicate. { 'bi'sil-ə-kət }

bismanol [MET] A magnetic alloy of bismuth and manganese. { 'biz-mə,nəl }

bismite [MINERAL] Bi₂O₃ A monoclinic mineral composed of bismuth trioxide; native bismuth ore, occurring as a yellow earth. Also known as bismuth ocher. { 'biz,mɪt }

bismuth [CHEM] A metallic element, symbol Bi, of atomic number 83 and atomic weight 208.980. [MINERAL] The brittle, rhombohedral mineral form of the native element bismuth. { 'biz-məθ }

bismuth alloy [MET] A group of low-melting alloys (many below 100°C) of bismuth combined with lead, tin, and cadmium; used in automatic sprinklers, special solders, safety plugs in compressed-gas cylinders, automatic shutoffs for water-heating systems, castings, and type metal. { 'biz-məθ 'al,oi }

bismuthate [INORG CHEM] A compound of bismuth in which the bismuth has a valence of +5; an example is sodium bismuthate, NaBiO₃. { 'biz-məθ,θāt }

bismuth blende See eulytite. { 'biz-məθ 'blend }

bismuth carbonate See bismuth subcarbonate. { 'bis-məθ 'kär-bə,nāt }

bismuth chloride [INORG CHEM] BiCl₃ A deliquescent material that melts at 230–232°C and decomposes in water to form the oxychloride; used to make bismuth salts. Also known as bismuth trichloride. { 'biz-məθ 'klɒr,ɪd }

bismuth chromate [INORG CHEM] Bi₂O₃·Cr₂O₃ An orange-red powder, soluble in alkalis and acids; used as a pigment. { 'biz-məθ 'krɒ,māt }

bismuth citrate [ORG CHEM] BiC₆H₅O₇ A salt of citric acid that forms white crystals, insoluble in water; used as an astringent. { 'biz-məθ 'si,tri:t }

bismuth germinate detector [NUCLEO] A high-efficiency, low-resolution detector of gamma rays that uses bismuth germinate (Bi₄Ge₃O₁₂), an intrinsic scintillator, whose large gamma-ray absorption coefficient makes possible a reduction in detector size. { 'biz-məθ 'jɛr-mə,nāt di,tek-tər }

bismuth glance See bismuthinite. { 'biz-məθ 'glans }

bismuth hydroxide [INORG CHEM] Bi(OH)₃ A water-insoluble, white powder; precipitated by hydroxyl ion from bismuth salt solutions. { 'biz-məθ hi'dræk,sɪd }

bismuthinite [MINERAL] Bi₂S₃ A mineral consisting of bismuth trisulfide, which has an orthorhombic structure and is

- known, used to find the index of refraction of powdered substances with a microscope. { 'in,deks ,lik-wəd }
- Index marker** [COMPUT SCI] The beginning (and end) of each track in a disk, which is recognized by a special sensing device within the disk mechanism. { 'in,deks ,märk-ər }
- Index mineral** [PETR] A mineral whose first appearance in passing from low to higher grades of metamorphism indicates the outer limit of a zone. { 'in,deks ,min-rəl }
- Index mirror** [NAV] The mirror attached to the index arm of a marine sextant. Also known as index glass. { 'in,deks ,mir-ər }
- Index number** [STAT] A number indicating change in magnitude, as of cost or of volume of production, as compared with the magnitude at a specified time, usually taken as 100; for example, if production volume in 1970 was two times as much as the volume in 1950 (taken as 100), its index number is 200. { 'in,deks ,nəm-bər }
- Index of absorption** See absorption index. { 'in,deks ,əv əb'sɔrp'shən }
- Index of aridity** [CLIMATOL] A measure of the precipitation effectiveness or aridity of a region, given by the following relationship: index of aridity = $P/(T + 10)$, where P is the annual precipitation in centimeters, and T the annual mean temperature in degrees Celsius. { 'in,deks ,əv ə'rid-əd-ē }
- Index of cooperation** [COMMUN] In rectilinear scanning or recording, the product of the total length of a scanning or recording line by the number of scanning or recording lines per unit length. { 'in,deks ,əv kō,əp-ə'rā-shən }
- Index of modulation** See modulation factor. { 'in,deks ,əv ,mäj-ə'lā-shən }
- Index of precision** [STAT] The constant h in the normal curve $y = K \exp [-h^2(x-u)^2]$; a large value of h indicates a high precision, or small standard deviation. { 'in,deks ,əv prə'sizh-ən }
- Index of refraction** [OPTICS] The ratio of the phase velocity of light in a vacuum to that in a specified medium. Also known as absolute index of refraction; absolute refractive constant; refractive constant; refractive index. { 'in,deks ,əv rɪ'frak-shən }
- Index of unsaturation** [ORG CHEM] A numerical value that represents the number of rings or double bonds in a molecule; a triple bond is considered to have the numerical value of 2. { 'in,deks ,əv ,ən,sach-ə'rā-shən }
- Index of work tolerance** [IND ENG] A measure of the period of time during which an individual can perform a given task with the required efficiency while maintaining appropriate levels of physiological and emotional well-being. { 'in,deks ,əv 'wɜrk ,təl-ə-rəns }
- Index plane** [GEOL] A surface used as a reference point in determining geological structure. { 'in,deks ,plān }
- Index plate** [DES ENG] A plate with circular graduations or holes arranged in circles, each circle with different spacing; used for indexing on machines. { 'in,deks ,plāt }
- Index point** [COMPUT SCI] A hardware reference mark on a disk or drum for use in timing. { 'in,deks ,pɔɪnt }
- Index prism** [NAV] A sextant prism which can be rotated to any angle corresponding to altitudes between established limits; the bubble or pendulum sextant counterpart of the index mirror of a marine sextant. { 'in,deks ,prɪz-əm }
- Index ratio** [ELECTROMAG] The ratio of the radius of a conductor used in induction heating to its skin depth at the frequency used. { 'in,deks ,rā-shō }
- Index register** [COMPUT SCI] A hardware element which holds a number that can be added to (or, in some cases, subtracted from) the address portion of a computer instruction to form an effective address. Also known as base register; B box; B line; B register; B store; modifier register. { 'in,deks ,rej-ə-stər }
- Index stock** [GRAPHICS] A stiff paper receptive to writing ink and to printing; available in smooth and antique finishes and used for index records and business cards. { 'in,deks ,stāk }
- Index thermometer** [ENG] A thermometer in which steel index particles are carried by mercury in the capillary and adhere to the capillary wall in the high and low positions, thus indicating minimum and maximum inertial scales. { 'in,deks ,θər'mā-məd-ər }
- Index word** See modifier. { 'in,deks ,wɜrd }
- India ink** [MATER] A permanent black ink made of lampblack and blue binder; some varieties are waterproof. Also known as Chinese ink; sumi ink. { 'in,dē-ə 'ɪŋk }
- indialite** [MINERAL] $Mg_2Al_4Si_5O_{18}$ A hexagonal cordierite mineral; it is isotopic with beryl. { 'in,dē-ə ,lɪt }
- Indian** See Indus. { 'in,dē-ən }
- Indianite** [MINERAL] A white porcelainlike clay mineral; a variety of halloysite found in Indiana. { 'in,dē-ə'nə ,ɪt }
- Indiana limestone** See spargenite. { 'in,dē-ə'nə 'lɪm,stōn }
- Indian balsam** See Peru balsam. { 'in,dē-ən 'bɔl-səm }
- Indian grass oil** See palmarosa oil. { 'in,dē-ən 'gras ,oɪl }
- Indian gum** [MATER] Any of the gums, such as ghatti gum and sterculia gum, with mucilage consistency from trees in the forests in India and Ceylon. { 'in,dē-ən 'gəm }
- Indian Ocean** [GEOGR] The smallest and geologically the most youthful of the three oceans, whose surface area is 29,300,000 square miles (75,900,000 square kilometers); it is bounded on the north by India, Pakistan, and Iran; on the east by the Malay Peninsula; on the south by Antarctica; and on the west by the Arabian peninsula and Africa. { 'in,dē-ən 'ō-shən }
- Indian red** [MATER] Iron-oxide-base, maroon pigment; used to polish gold, silver, and other metals. Also known as iron saffron. { 'in,dē-ən 'red }
- Indian spring low water** [OCEANOGR] An arbitrary tidal datum approximating the level of the mean of the lower low waters at spring time, first used in waters surrounding India. Also known as harmonic tide plane; Indian tide plane. { 'in,dē-ən 'sprɪŋ ,lō 'wɔd-ər }
- Indian summer** [CLIMATOL] A period, in mid- or late autumn, of abnormally warm weather, generally clear skies, sunny but hazy days, and cool nights; in New England, at least one killing frost and preferably a substantial period of normally cool weather must precede this warm spell in order for it to be considered a true Indian summer; it does not occur every year, and in some years there may be two or three Indian summers; the term is most often heard in the northeastern United States, but its usage extends throughout English-speaking countries. { 'in,dē-ən 'səm-ər }
- Indian tide plane** See Indian spring low water. { 'in,dē-ən 'tɪd ,plān }
- Indian tragacanth** See karaya gum. { 'in,dē-ən 'trag-ə ,kanth }
- Indian yellow** [MATER] A yellow pigment which may be aureolin, made of cobalt and potassium nitrates; or puree, the impure basic magnesium salt of euxanthic acid; or the synthetic dye primuline. { 'in,dē-ən 'yel-ō }
- indican** [BIOCHEM] C_8H_6NOSOK The potassium salt of indoxylsulfate found in urine as a result of bacterial action on tryptophan in the bowel. [ORG CHEM] $C_{14}H_7O_6N$ A glucoside of indoxyl occurring in the indigo plant; on hydrolysis indican gives rise to indoxyl, which is oxidized to indigo by air. { 'in,də ,kan }
- indicated airspeed** [AERO ENG] The airspeed as shown by a differential-pressure airspeed indicator, uncorrected for instrument and installation errors; a simple computation for altitude and temperature converts indicated airspeed to true airspeed. Abbreviated IAS. { 'in,də ,kād-əd 'er ,spɛd }
- indicated air temperature** [METEOROL] The uncorrected reading from the free air temperature gage. Also known as outside air temperature. { 'in,də ,kād-əd 'er ,tem-prə-ʃhər }
- indicated altitude** [AERO ENG] The uncorrected reading of a barometric altimeter. { 'in,də ,kād-əd 'alt-ə ,tɪd }
- indicated horsepower** [MECH ENG] The horsepower delivered by an engine as calculated from the average pressure of the working fluid in the cylinders and the displacement. Abbreviated ihp. { 'in,də ,kād-əd 'hɔrs ,pau-ər }
- indicated ore** [MIN ENG] A known mineral deposit for which quantitative estimates are made partly from inference and partly from specific sampling. Also known as probable ore. { 'in,də ,kād-əd 'ɔr }
- indicating gage** [ENG] A gage consisting essentially of a case and mounting, a spindle carrying the contact point, an amplifying mechanism, a pointer, and a graduated dial; used to amplify and measure the displacement of a movable contact point. { 'in,də ,kād-ɪŋ ,gāj }
- indicating instrument** [ENG] An instrument in which the present value of the quantity being measured is visually indicated. { 'in,də ,kād-ɪŋ ,ɪn-strə-mənt }
- indication** [ENG] In ultrasonic testing, determination of the presence of a flaw by detection of a reflected ultrasonic beam. { 'in,də 'kā-shən }

ecule that undergoes addition with an unexcited molecule of the same species. { 'föd-ö,di-mə-rə'zä-shən }

photodiode [ELECTR] A semiconductor diode in which the reverse current varies with illumination; examples include the alloy-junction photocell and the grown-junction photocell. Also known as photoconductor diode. { 'föd-ö,di,död }

photodisintegration [NUC PHYS] The breakup of an atomic nucleus into two or more fragments as a result of bombardment by gamma radiation. Also known as Chadwick-Goldhaber effect. { 'föd-ö,di,sin-tə'grä-shən }

photodissociation [PHYS CHEM] The removal of one or more atoms from a molecule by the absorption of a quantum of electromagnetic energy. { 'föd-ö,di,sö-shē'ä-shən }

photodosimetry [NUCLEO] Determination of the cumulative dose of ionizing radiation by use of photographic film. { 'föd-ö,dö'sim-ə-trē }

photodraft [DES ENG] A photographic reproduction of a master layout or design on a specially prepared emulsion-coated piece of sheet metal; used as a master in a tool-construction department. { 'föd-ö,draft }

photoecology [ENG] The application of air photography to ecology, integrated land resource studies, and forestry. { 'föd-ö,i'käl-ə-jē }

photoelastic effect [OPTICS] Changes in optical properties of a transparent dielectric when it is subjected to mechanical stress, such as mechanical birefringence. Also known as photoelasticity. { 'föd-ö,i'las'tik i'fekt }

photoelasticity [OPTICS] 1. An experimental technique for the measurement of stresses and strains in material objects by means of the phenomenon of mechanical birefringence. 2. See photoelastic effect. { 'föd-ö,i'las'tis-əd-ē }

photoelectret [SOLID STATE] An electret produced by the removal of light from an illuminated photoconductor in an electric field. { 'föd-ö,i'lek-trət }

photoelectric [ELECTR] Pertaining to the electrical effects of light, such as the emission of electrons, generation of voltage, or a change in resistance when exposed to light. { 'föd-ö,i'lek-trik }

photoelectric absorption [ELECTR] Absorption of photons in one of the several photoelectric effects. { 'föd-ö,i'lek-trik əb'sörp-shən }

photoelectric absorption analysis [ANALY CHEM] Type of activation analysis in which the γ -photon gives all of its energy to an electron in the crystal under analysis, generating a maximum-sized pulse for that particular γ -energy. { 'föd-ö,i'lek-trik əb'sörp-shən ə,näl-ə'səs }

photoelectric cell See photocell. { 'föd-ö,i'lek-trik 'sel }

photoelectric color comparator See color comparator. { 'föd-ö,i'lek-trik 'käl-ər kəm,par-əd-ər }

photoelectric colorimeter [ENG] A colorimeter that uses a phototube or photocell, a set of color filters, an amplifier, and an indicating meter for quantitative determination of color. { 'föd-ö,i'lek-trik 'käl-ər'im-əd-ər }

photoelectric colorimetry [ANALY CHEM] Measurement of the colorant concentration in a solution by means of the tristimulus values of three primary light filter-photocell combinations. { 'föd-ö,i'lek-trik 'käl-ər'im-ə-trē }

photoelectric constant [ELECTR] The ratio of the frequency of radiation causing emission of photoelectrons to the voltage corresponding to the energy absorbed by a photoelectron; equal to Planck's constant divided by the electron charge. { 'föd-ö,i'lek-trik 'kän-stənt }

photoelectric control [ELECTR] Control of a circuit or piece of equipment by changes in incident light. { 'föd-ö,i'lek-trik kən'tröl }

photoelectric counter [ELECTR] A photoelectrically actuated device used to record the number of times a given light path is intercepted by an object. { 'föd-ö,i'lek-trik 'kaunt-ər }

photoelectric cutoff register control [ELECTR] Use of a photoelectric control system as a longitudinal position regulator to maintain the position of the point of cutoff with respect to a repetitive pattern of moving material. { 'föd-ö,i'lek-trik 'kət,öf,'rej-ə-stər kən'tröl }

photoelectric densitometer [ENG] An electronic instrument used to measure the density or opacity of a film or other material; a beam of light is directed through the material, and the amount of light transmitted is measured with a photocell and meter. { 'föd-ö,i'lek-trik ,den-sə'täm-əd-ər }

photoelectric detector See photodetector. { 'föd-ö,i'lek-trik di'tek-tər }

photoelectric device [ELECTR] A device which gives an electrical signal in response to visible, infrared, or ultraviolet radiation. { 'föd-ö,i'lek-trik di'vīs }

photoelectric door opener [CONT SYS] A control system that employs a photocell or other photo device, used to open and close a power-operated door. { 'föd-ö,i'lek-trik 'dör,öp-ən-ər }

photoelectric effect See photoelectricity. { 'föd-ö,i'lek-trik i'fekt }

photoelectric electron-multiplier tube See multiplier phototube. { 'föd-ö,i'lek-trik i'lek,trä'n 'mäl-tə,plī-ər ,tüb }

photoelectric flame-failure detector [CONT SYS] A photoelectric control that cuts off fuel flow when the fuel-consuming flame is extinguished. { 'föd-ö,i'lek-trik 'fläm ,fäi-yər di'tek-tər }

photoelectric fluorometer [ENG] Device using a photoelectric cell to measure fluorescence in a chemical sample that has been excited (one or more electrons have been raised to higher energy level) by ultraviolet or visible light; used for analysis of chemical mixtures. { 'föd-ö,i'lek-trik flu'räm-əd-ər }

photoelectric imaging [GRAPHICS] The process of storing an image in a ferroelectric material by utilizing either the intrinsic or extrinsic photosensitivity in conjunction with the ferroelectric properties of the material. { 'föd-ö,i'lek-trik 'im-ə-jin }

photoelectric infrared radiation See near-infrared radiation. { 'föd-ö,i'lek-trik 'in-frə,red ,rä-dē'ä-shən }

photoelectric intrusion detector [ELECTR] A burglar-alarm system in which interruption of a light beam by an intruder reduces the illumination on a phototube and thereby closes an alarm circuit. { 'föd-ö,i'lek-trik in'trü-zhən di'tek-tər }

photoelectricity [ELECTR] The liberation of an electric charge by electromagnetic radiation incident on a substance; includes photoemission, photoionization, photoconduction, the photovoltaic effect, and the Auger effect (an internal photoelectric process). Also known as photoelectric effect; photoelectric process. { 'föd-ö,i'lek'tris-əd-ē }

photoelectric lighting control [ELECTR] Use of a photoelectric relay actuated by a change in illumination in a given area or at a given point. { 'föd-ö,i'lek-trik 'līd-in kən'tröl }

photoelectric liquid-level indicator [ENG] A level indicator in which rising liquid interrupts the light beam of a photoelectric control system; used in a tank or process vessel. { 'föd-ö,i'lek-trik 'lik-wəd 'lev-əl 'in-də,kād-ər }

photoelectric loop control [CONT SYS] A photoelectric control system used as a position regulator for a loop of material passing from one strip-processing line to another that may travel at a different speed. Also known as loop control. { 'föd-ö,i'lek-trik 'lūp kən'tröl }

photoelectric magnitude [ASTRON] The magnitude of a celestial object, as measured by a photoelectric photometer attached to a telescope. { 'föd-ö,i'lek-trik 'mag-nə,tüd }

photoelectric photometer [ENG] A photometer that uses a photocell, phototransistor, or phototube to measure the intensity of light. Also known as electronic photometer. { 'föd-ö,i'lek-trik fə'täm-əd-ər }

photoelectric photometry [OPTICS] In contrast to the methods of visual photometry, an objective approach to the problems of photometry, wherein any of several types of photoelectric devices are used to replace the human eye as the sensing element. { 'föd-ö,i'lek-trik fə'täm-ə-trē }

photoelectric plethysmograph [MED] A medical instrument for measuring and recording ear opacity by means of a tiny phototube and lamp clipped to the ear, as a measure of the state of fullness of blood vessels; also worn by aircraft pilots during high-altitude flights, as an alarm indicating the need for more oxygen. { 'föd-ö,i'lek-trik plə'thiz-mə,graf }

photoelectric process See photoelectricity. { 'föd-ö,i'lek-trik 'präs-əs }

photoelectric pyrometer [ENG] An instrument that measures high temperatures by using a photoelectric arrangement to measure the radiant energy given off by the heated object. { 'föd-ö,i'lek-trik pī'räm-əd-ər }

photoelectric reader [COMPUT SCI] A device for reading information stored on paper tape or cards; data are read by sensing the presence or absence of holes. { 'föd-ö,i'lek-trik 'rēd-ər }

photoelectric reflectometer [ENG] A reflectometer that uses a photocell or phototube to measure the diffuse reflection of

located facilities) to produce simultaneous indication of bearing and distance. { 'pō-lər kō'ōrd-ən-ət ,nav-ə'gā-shən ,sist-əm }

polar coordinates [MATH] A point in the plane may be represented by coordinates (r, θ) , where θ is the angle between the positive x -axis and the ray from the origin to the point, and r the length of that ray. { 'pō-lər kō'ōrd-ən-əts }

polar covalent bond [PHYS CHEM] A bond in which a pair of electrons is shared in common between two atoms, but the pair is held more closely by one of the atoms. { 'pō-lər kō'vā-lənt ,bānd }

polar crystal See ferroelectric crystal. { 'pō-lər 'krist-əl }

polar cyclone See polar vortex. { 'pō-lər 'sīklōn }

polar desert [GEOGR] A high-latitude desert where the existing moisture is frozen in ice sheets and is thus unavailable for plant growth. Also known as arctic desert. { 'pō-lər 'dez-ərt }

polar developable [MATH] The envelope of the normal planes of a space curve. { 'pō-lər di'veləp-ə-bəl }

polar diagram [PHYS] A diagram employing polar coordinates to show the magnitude of a quantity in some or all directions from a point; examples include directivity patterns and radiation patterns. { 'pō-lər 'dī-ə ,grām }

polar distance [ASTRON] Angular distance from a celestial pole; the arc of an hour circle between a celestial pole, usually the elevated pole, and a point on the celestial sphere, measured from the celestial pole through 180° . { 'pō-lər 'dist-əns }

polar easterlies [METEOROL] The rather shallow and diffuse body of easterly winds located poleward of the subpolar low-pressure belt; in the mean in the Northern Hemisphere, these easterlies exist to an appreciable extent only north of the Aleutian low and Icelandic low. { 'pō-lər 'ēs-tər ,lēz }

polar easterlies index [METEOROL] A measure of the strength of the easterly wind between the latitudes of 55° and 70° N; the index is computed from the average sea-level pressure difference between these latitudes and is expressed as the east to west component of geostrophic wind in meters and tenths of meters per second. { 'pō-lər 'ēs-tər ,lēz 'in ,deks }

polar electrojet [GEOPHYS] An intense current that flows in a relatively narrow band of the auroral zone-ionosphere during disturbances of the magnetosphere. { 'pō-lər i'lek-trə-jet }

polar equation [MATH] An equation expressed in polar coordinates. { 'pō-lər i'kwā-zhən }

polar firm [HYD] Firm formed at low temperatures with no melting or liquid water present. Also known as dry firm. { 'pō-lər 'fərm }

polar form [MATH] A complex number $x + iy$ has as polar form $re^{i\theta}$, where (r, θ) are the polar coordinates corresponding to the point of the plane with rectangular coordinates (x, y) ; that is, $r = \sqrt{x^2 + y^2}$ and $\theta = \arctan y/x$. { 'pō-lər 'fərm }

polar front [METEOROL] The semipermanent, semicontinuous front separating air masses of tropical and polar origin; this is the major front in terms of air mass contrast and susceptibility to cyclonic disturbance. { 'pō-lər 'frənt }

polar front theory [METEOROL] A theory whereby a polar front, separating air masses of polar and tropical origin, gives rise to cyclonic disturbances which intensify and travel along the front, passing through various phases of a characteristic life history. { 'pō-lər 'frənt ,thē-ə-rē }

polar glacier [HYD] A glacier whose temperature is below freezing throughout its mass, and on which there is no melting during any season. { 'pō-lər 'glā-shər }

polar high See arctic high; subpolar high. { 'pō-lər 'hī }

polar ice [OCEANOGR] Sea ice that is more than 1 year old; the thickest form of sea ice. Also known as polar-cap ice. { 'pō-lər 'īs }

polarimeter [OPTICS] An instrument used to determine the rotation of the plane of polarization of plane polarized light when it passes through a substance; the light is linearly polarized by a polarizer (such as a Nicol prism), passes through the material being analyzed, and then passes through an analyzer (such as another Nicol prism). { 'pō-lə-rim-əd-ər }

polarimetric analysis [ANALY CHEM] A method of chemical analysis based on the optical activity of the substance being determined; the measurement of the extent of the optical rotation of the substance is used to identify the substance or determine its quantity. { 'pō-lə-rə-mē-trik ə'nal-ə-səs }

polarimetry [OPTICS] Determination of the rotation of the plane of polarization of plane polarized light when it passes through a substance, using a polarimeter. { 'pō-lə-rim-ə-trē }

Polaris [ASTRON] A creamy supergiant star of stellar magnitude 2.0, spectral classification F8, in the constellation Ursa Minor; marks the north celestial pole, being about 1° from this point; the star Ursae Minoris. Also known as North Star; Pole Star. { 'pə-lar-əs }

polariscope [OPTICS] Any of several instruments used to determine the effects of substances on polarized light, in which linearly or elliptically polarized light passes through the substance being studied, and then through an analyzer. { 'pə-lar-ə ,skōp }

Polaris correction [NAV] A correction to be applied to the corrected sextant altitude of Polaris to obtain latitude; this correction for the offset of Polaris from the north celestial pole varies with the local hour angle of Aries, latitude, and date. { 'pə-lar-əs kə ,rek-shən }

Polaris missile [ORD] A U.S. Navy surface-to-surface intermediate-range ballistic missile designed to be launched from submarines and surface ships for accurate bombardment of small target areas with conventional or nuclear warheads at ranges up to 2500 nautical miles (4600 kilometers). { 'pə-lar-əs 'mis-əl }

polariton [SOLID STATE] A coupled mode of motion in an ionic crystal due to the coupling between the electromagnetic field and transverse optical phonons of long wavelength. { 'pə-lar-ə ,tān }

polarity [COMMUN] 1. The direction in which a direct current flows; in a teletypewriter system. 2. The sense of the potential of a portion of a television picture signal representing a dark area of a scene relative to the potential of a portion of the signal representing a light area. [MATH] Property of a line segment whose two ends are distinguishable. [MOL BIO] The orientation of a strand of polynucleotide with respect to its partner, expressed in terms of nucleotide linkages. [PHYS] Property of a physical system which has two points with different (usually opposite) characteristics, such as one which has opposite charges or electric potentials, or opposite magnetic poles. { 'pə-lar-əd-ē }

polarity effect [ELECTR] An effect for which the breakdown voltage across a vacuum separating two electrodes, one of which is pointed, is much higher when the pointed electrode is the anode. { 'pə-lar-əd-ē i ,fekt }

polarity epoch [GEOPHYS] A period of time during which the earth's magnetic field was predominantly of a single polarity. { 'pə-lar-əd-ē ,ep-ək }

polarity event [GEOPHYS] A period of no more than about 100,000 years when the earth's magnetic polarity was opposite to the predominant polarity of that polarity epoch. { 'pə-lar-əd-ē i ,vent }

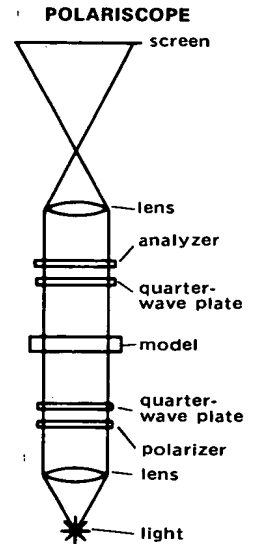
polarity zone [GEOL] In stratigraphy, a material unit that is defined in terms of magnetic polarity, that is, reversals of the earth's magnetic field. { 'pə-lar-əd-ē ,zōn }

polarizability [ELEC] The electric dipole moment induced in a system, such as an atom or molecule, by an electric field of unit strength. { 'pō-lə-rīz-ə'bīl-əd-ē }

polarizability catastrophe [ELEC] According to a theory using the Lorentz field concept, the phenomenon where, at a certain temperature, the dielectric constant of a material becomes infinite. { 'pō-lə-rīz-ə'bīl-əd-ē kə'tas-trə-fē }

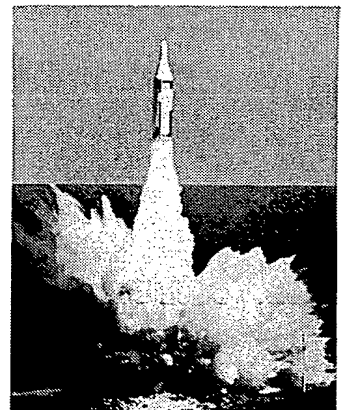
polarizability ellipsoid See index ellipsoid. { 'pō-lə-rīz-ə'bīl-əd-ē i'lip-sōid }

polarization [ELEC] 1. The process of producing a relative displacement of positive and negative bound charges in a body by applying an electric field. 2. A vector quantity equal to the electric dipole moment per unit volume of a material. Also known as dielectric polarization; electric polarization. 3. A chemical change occurring in dry cells during use, increasing the internal resistance of the cell and shortening its useful life. [PHYS] 1. Phenomenon exhibited by certain electromagnetic waves and other transverse waves in which the direction of the electric field or the displacement direction of the vibrations is constant or varies in some definite way. Also known as wave polarization. 2. The direction of the electric field or the displacement vector of a wave exhibiting polarization (first definition). 3. The process of bringing about polarization (first definition) in a transverse wave. 4. Property of a collection of particles with spin, in which the majority have spin components pointing in one direction, rather than at random. { 'pō-lə-rīz-ə'shən }



A polariscope used in measuring photoelastic stress.

POLARIS MISSILE



Polaris missile being fired from a submerged submarine. (Official U.S. Navy photograph)

of petroleum naphtha into more volatile products of higher octane number; represents the total effect of numerous simultaneous reactions, such as cracking, polymerization, dehydrogenation and isomerization. { 'rē'fōrm-ig }

refracted ray [PHYS] A ray extending onward from the point of refraction. { ri'frak-təd 'rā }

refracted wave [PHYS] That portion of an incident wave which travels from one medium into a second medium. Also known as transmitted wave. { ri'frak-təd 'wāv }

refracting angle See apical angle. { ri'frak-tiŋ, aŋ-gəl }

refracting edge [OPTICS] The intersection of the two refracting faces of a prism. { ri'frak-tiŋ, ej }

refracting sphere [OPTICS] A sphere made of a transparent material whose index of refraction differs from the medium surrounding it, so that it refracts light passing through it. { ri'frak-tiŋ, sfir }

refracting telescope [OPTICS] A telescope in which a lens gathers light and forms a real image of an object. Also known as refractor telescope. { ri'frak-tiŋ 'tel-ə, sköp }

refraction [ELECTROMAG] The change in direction of lines of force of an electric or magnetic field at a boundary between media with different permittivities or permeabilities. [PHYS] The change of direction of propagation of any wave, such as an electromagnetic or sound wave, when it passes from one medium to another in which the wave velocity is different, or when there is a spatial variation in a medium's wave velocity. { ri'frak-shən }

refraction coefficient [OCEANOGR] The square root of the ratio of the spacing between orthogonals in deep water and in shallow water; it is a measure of the effect of refraction in diminishing wave height by increasing the length of the wave crest. { ri'frak-shən, kō-i, fish-ənt }

refraction diagram [OCEANOGR] A chart showing the position of the wave crests at a particular time, or the successive positions of a particular wave crest as it moves shoreward. { ri'frak-shən, dī-ə, gram }

refraction error [NAV] An error due to refraction, particularly such an error in a sextant altitude, due to atmospheric refraction. { ri'frak-shən, ər-ər }

refraction loss [ELECTROMAG] Portion of the transmission loss that is due to refraction resulting from nonuniformity of the medium. { ri'frak-shən, lōs }

refraction process [ENG] Seismic (reflection) survey in which the distance between the explosive shot and the receivers (sensors) is large with respect to the depths to be mapped. { ri'frak-shən, prə-sēs }

refraction profile [ENG] A seismic profile obtained by designing the spread geometry in such a manner as to enhance refracted energy. { ri'frak-shən, prō-fil }

refraction shooting [ENG] A type of seismic shooting based on the measurement of seismic energy as a function of time after the shot and of distance from the shot, by determining the arrival times of seismic waves which have traveled nearly parallel to the bedding in high-velocity layers, in order to map the depth of such layers. { ri'frak-shən, shūd-iŋ }

refractive constant See index of refraction. { ri'frak-tiv 'kän-stənt }

refractive index See index of refraction. { ri'frak-tiv, in, deks }

refractive modulus See modified index of refraction. { ri'frak-tiv 'māj-ə-ləs }

refractivity [ELECTROMAG] 1. Some quantitative measure of refraction, usually a measure of the index of refraction. 2. The index of refraction minus 1. { rē, frak'tiv-əd-ē }

refractometer [ENG] An instrument used to measure the index of refraction of a substance in any one of several ways, such as measurement of the refraction produced by a prism, measurement of the critical angle, observation of an interference pattern produced by passing light through the substance, and measurement of the substance's dielectric constant. { rē, frak'tām-əd-ər }

refractometry [OPTICS] The measurement of the index of refraction of a substance; it is an important tool in analytical chemistry. { rē, frak'tām-ə-trē }

refractor telescope See refracting telescope. { ri'frak-tər 'tel-ə, sköp }

refractory [MATER] 1. A material of high melting point. 2. The property of resisting heat. [MED] Not readily yielding to treatment. { ri'frak-trē }

refractory cement [MATER] Any of a variety of mixtures,

such as fireclay-silica-ganister mixture, or fireclay mixed with crushed brick, or fireclay and silica sand, with a refractory range of 2600–2800°F (1412–1523°C); used for furnace and oven linings and for fillers. { ri'frak-trē si'ment }

refractory clay [MATER] Clay with a melting point above 1600°C; used to make firebrick and linings for furnaces and reactors. { ri'frak-trē 'klā }

refractory coating [MATER] A coating composed of a refractory material. { ri'frak-trē 'kōd-iŋ }

refractory concrete [MATER] Heat-resistant concrete made with high-alumina or calcium-aluminate cement and a refractory aggregate. { ri'frak-trē 'kän, krēt }

refractory enamel [MATER] An enamel for coating and protecting metals against attack by hot gases. { ri'frak-trē i'nam-əl }

refractory hard metals [CHEM] True chemical compounds composed of two or more metals in the crystalline form, and having a very high melting point and high hardness. { ri'frak-trē 'hārd 'med-əlz }

refractory-lined firebox boiler [MECH ENG] A horizontal fire-tube boiler with the front portion of the shell located over a refractory furnace; the rear of the shell contains the first-pass tubes, and the second-pass tubes are located in the upper part of the shell. { ri'frak-trē 'lind 'fir, bāks, bōil-ər }

refractory metal [MET] A metal or alloy that is heat-resistant, having a high melting point. { ri'frak-trē 'med-əl }

refractory period [PHYSIO] A brief period of time following the stimulation of a nerve during which the nerve will not respond to a second stimulus. { ri'frak-trē, pīr-əd }

refractory sand [MATER] Sand used for refractory which is capable of resisting high temperatures. { ri'frak-trē 'sand }

refrangible [PHYS] Capable of being refracted. { ri'fran-jə-bəl }

refresh [COMPUT SCI] A process of periodically replacing data to prevent the data from decaying, as on a cathode-ray-tube display or in a dynamic random-access memory. { ri'fresh }

refrigerant [MATER] A substance that by undergoing a change in phase (liquid to gas, gas to liquid) releases or absorbs a large latent heat in relation to its volume, and thus effects a considerable cooling effect; examples are ammonia, sulfur dioxide, ethyl or methyl chloride (these are no longer widely used), and the fluorocarbons, such as Freon, Ucon, and Genetron. { ri'fri-jə-rənt }

refrigerant 23 See fluoroform. { ri'fri-jə-rənt, 'twen-tē-thrē }

refrigerated truck [MECH ENG] An insulated truck equipped and used as a refrigerator to transport fresh perishable or frozen products. { ri'fri-jə-rād-əd 'trāk }

refrigeration [MECH ENG] The cooling of a space or substance below the environmental temperature. { ri, fri-jə-rā-shən }

refrigeration condenser [MECH ENG] A vapor condenser in a refrigeration system, where the refrigerant is liquefied and discharges its heat to the environment. { ri, fri-jə-rā-shən kən, den-sər }

refrigeration cycle [THERMO] A sequence of thermodynamic processes whereby heat is withdrawn from a cold body and expelled to a hot body. { ri, fri-jə-rā-shən, sī-kəl }

refrigeration oil [MATER] A mineral oil with all moisture and wax removed; used for lubricating refrigerating machinery. { ri, fri-jə-rā-shən, ōil }

refrigeration system [MECH ENG] A closed-flow system in which a refrigerant is compressed, condensed, and expanded to produce cooling at a lower temperature level and rejection of heat at a higher temperature level for the purpose of extracting heat from a controlled space. { ri, fri-jə-rā-shən, sis-təm }

refrigerator [MECH ENG] An insulated, cooled compartment. { ri'fri-jə-rād-ər }

refrigerator car [MECH ENG] An insulated freight car constructed and used as a refrigerator. { ri'fri-jə-rād-ər, kār }

Refsum's disease [MED] A familial disorder characterized by visual disturbances, ataxia, neuritic changes, and cardiac damage, associated with high blood level of phytanic acid. { 'rē-səmz dī, zēz }

Refugian [GEOL] A North American stage of geologic time in the Eocene and Oligocene, above the Fresnian and below the Zemorrian. { rə'fyū-jē-ən }

refugium [ECOL] An area which has escaped the great changes which occurred in the region as a whole, often providing conditions in which relic colonies can survive; for example, a drift-

On the c v r: Ph t micr graph of crystals of vitamin B₁.
(Dennis Kunkel, University of Hawaii)

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